2017

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SOLAR TRAINING AND HIRING INSIGHTS

A Solar Training Network Research Report

SOLAR TRAINING NETWORK
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This material is based upon work supported by the Department of Energy, Office of Energy Efficiency and Renewable Energy (EERE), under Award Number DE-EE0007319, Nationally Administered by The Solar Foundation.

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ACKNOWLEDGEMENTS

The Solar Training Network is a program funded by the U.S. Department of Energy's SunShot Initiative and administered by The Solar Foundation. The Solar Training Network is designed to help meet the workforce needs of the solar industry through solar training and strategic employment partnerships. The Solar Foundation is a national 501(c)(3) nonprofit organization whose mission is to accelerate adoption of the world's most abundant energy source.

The Solar Training Network team would like to acknowledge and thank the research partners and contributors to this report. Thank you to Lyra Rakusin and Tommy Cleveland, North Carolina Clean Energy Technology Center, NC State University, for collecting and analyzing employer hiring and promotion data; Colleen McCann Kettles, Florida Solar Energy Center, University of Central Florida for conducting interviews and synthesizing data on tools and resources; Mark White, Ph.D. for guidance on the development of the geographic demand index; the entire research team at the Solar Energy Industries Association (SEIA) for providing invaluable labor data and analysis support; and Alex Winn, The Solar Foundation for editing and policy insight.

The Solar Foundation would also like to thank all the solar employers and training providers who participated in the various surveys, interviews, and data collection efforts that were conducted. Your responses were critical in providing us with timely data and insights that we hope will provide lasting benefits for the solar industry.

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Please cite this publication when referencing this material as "Solar Hiring and Training Insights 2017, The Solar Foundation, available at: SolarTrainingUSA.org"

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SOLAR TRAINING AND HIRING INSIGHTS 2017

A Solar Training Network Research Report

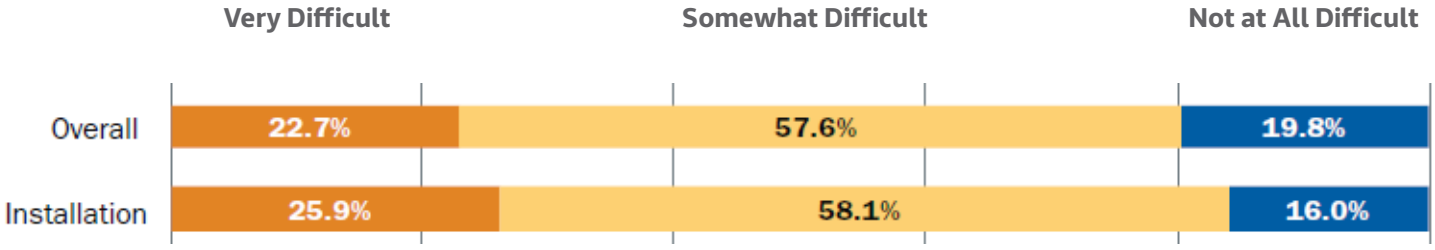
In surveys of employers conducted in 2015 and 2016, U.S. solar employers reported experiencing high levels of difficulty filling open positions. This report summarizes research by the Solar Training Network – a program funded by the U.S. Department of Energy SunShot Initiative – that analyzes why the solar industry is experiencing such high levels of difficulty finding and retaining qualified applicants; explores the business case for investing resources in solar workforce development; and examines what can and should be done to efficiently and effectively facilitate solar hiring. The research aggregates data from several efforts, including an extensive survey of more than 400 solar installers, as well as smaller case studies and in-depth interviews with dozens of solar employers, trainers, and workforce development boards.[1]

The cost of solar installations have dropped precipitously over the last several years and, as a result, the rate of solar photovoltaic (PV) deployment has grown exponentially, with annual installed capacity growing from 1,925 megawatts (MW) in 2011 to 14,626 MW installed in 2016.[2] The U.S. solar workforce responded in tandem, with job growth increasing 247% over the same time period, surging from 105,145 to 260,077 solar workers in just five years.[3] In 2016 alone, the solar workforce added more than 51,000 new solar jobs, 80% of which were newly created positions.[4]

The majority of the new solar industry jobs added in the last five years were positions within installation firms – with 93,199 installation related jobs added between 2010 and 2016.[5] Despite growing efforts by public and private solar training organizations, installation firms from around the country still report significant difficulty finding qualified candidates. **In 2016, 84% of solar installers reported difficulty filling open installation positions.**[6]

Solar employers expect to add 26,258 positions in 2017, a 10% growth in the workforce. While this expected employment growth may be lower than the 24.5% experienced in 2016, a 10% increase still represents significant growth in an industry with an already insufficient applicant pool. In addition, employment growth in the overall U.S. economy is projected to continue, meaning competition for qualified workers from other industries will likely increase as well.

HIRING DIFFICULTY FOR OVERALL SOLAR INDUSTRY VS. INSTALLATION SECTOR, 2016

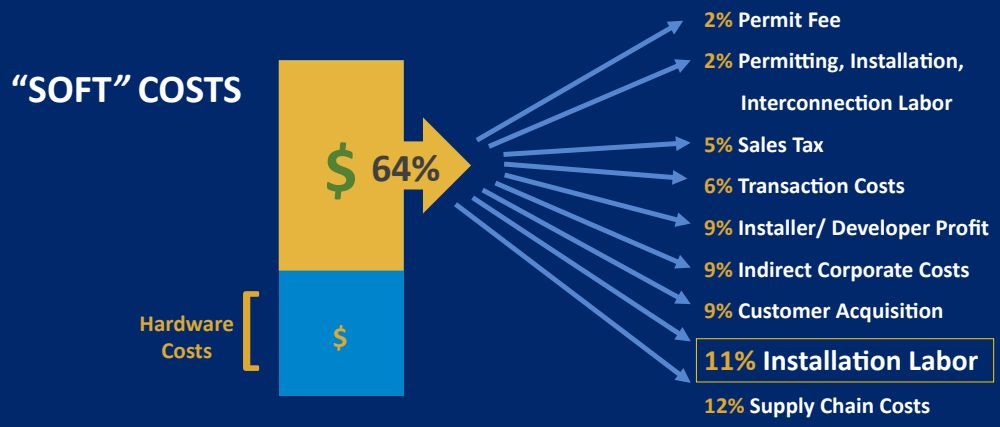


Despite the increasing maturity of the solar market, solar employers' difficulty finding qualified workers has only increased in recent years. Between 2014 and 2016, solar installation firms reporting that it was "very difficult" to find qualified workers rose from 19.4% to 25.9%.[7] In some states, the struggle to find and retain qualified solar employees seems almost ubiquitous among employers. The top five states with the highest reported difficulty hiring[8] were Indiana (100%), New Mexico (95.5%), Oregon (93.3%), Utah (91.2%), and Hawaii (90.9%).

While an insufficient number of applicants is an issue in many regions, with half (50%) of all firms nationally reporting a deficient supply of applicants, the quality of new hires is frequently cited as a more pressing issue. **Over three quarters (77.6%) of all employers cite difficulty finding candidates with any training specific to the position, and a similar number (77.9%) report difficulty finding candidates with any relevant work experience.** These results were further corroborated by the 2016 National Solar Jobs Census which found that lack of applicant experience/training, certifications, and an insufficient applicant pool were the top three most significant contributors to difficulty in hiring by employers.[9]

TOP STATES - HIRING DIFFICULTY

The gap between solar workforce supply and demand, and associated difficulty filling open positions, increases the ultimate cost of deploying solar. **In a 2015 survey, two thirds of employers indicated that difficulty filling open positions was both costing their firm money and restricting their ability to grow.** Recruitment costs, and the opportunity cost of delayed hiring and missed business opportunities, are substantial. When asked to quantify the impact unfilled positions had, 38.7% of employers reported costs greater than $10,000 per position, with 13.7% reporting costs greater than $50,000. Clearly improving employee pipelines and decreasing difficulty finding and hiring qualified solar workers can have a tremendous economic impact on the solar industry.



Soft costs – the non-hardware costs of a solar installation, which include the cost of recruiting, hiring, training, and retaining employees – account for a significant portion (64%) of the final price per watt of installed solar in the U.S. [10] **Installation labor costs alone account for 11% of the total cost of a new solar PV system.** These soft costs are keeping U.S. solar PV installation prices above those in many other countries, despite comparable hardware costs, [11] leading to lower numbers of installed systems than would otherwise be possible.

The research conducted by The Solar Training Network aims to provide new information and increase understanding of the solar training and hiring practices that may reduce installation labor soft costs. To accomplish this, the research focuses on three essential questions. **Why** should solar employers invest in training and workforce development? **What** are solar employers looking for and what are the best practices for training potential and existing solar workers to help meet that demand? Lastly, **where** should solar workforce development tools and resources be deployed to most efficiently and effectively bridge the gap between solar workforce supply and demand?

THE BUSINESS CASE FOR INVESTMENT IN TRAINING

Understandably, a major focus of solar training and safety education aims to decrease mistakes and injury rates. Mistakes by solar installers can be costly for a company and the solar industry as a whole, and can even lead to serious injury or death. According to a 2014 study, a typical residential rooftop installation that has been improperly installed can lead to call-backs for additional removal, repair, and reinstallation, costing between $2,500 and $7,500.[12] **If improved training procedures could lead to a 1% decrease in the rate of such call-backs, it could save the solar industry more than ten million dollars in less than a year.[13]**

Additionally, research has shown that incumbent training and advancement opportunities are primary drivers of increased employee satisfaction.[14] Increased job satisfaction can reduce employee turnover and improve productivity, which can also enhance company revenues.[15] A continued focus on training to increase labor efficiency and lower employee turnover has the potential to yield tremendous savings for employers.

Seeking to examine the business case for the investment of resources by employers in training after hire, this research effort consisted of an in-depth analysis of the hiring, training, and promotion practices of ten solar installation firms. Both the costs and benefits associated with each company's hiring practices were assessed. **The initial results show a positive trend between investment in training and increased labor efficiency.** This result is not surprising, as it is a trend that has been affirmatively demonstrated in similar industries.[16]

TRAINING REQUIRED AND FINANCED BY COMPANY, BY POSITION.

Company	# of Hours for Required Onboarding Technical Training	Proficiency Requirement to move to PV2/ Jr. Installer	Proficiency and Training Requirement to move to PV3/Sr. Installer	Average Number of Months to get to PV3/ Sr. Installer	Proficiency Requirement to become Crew Lead
A	40 hour in-house	Passed Probation, up to 6 months	Work Independently, Work Safely	6–12 months	Years in Company
B	40 hour in-house	No data	No data	No data	Electrical License in required locations
C	2-3 weeks supervision with Operations Director prior to crew assignment	N/A	N/A	N/A	Electrical License
D	Installers are taking semester Journeyman classes.	Review	Review	6 months	Electrical License. Previously NABCEP Certification and Electrical License
E	OSHA 10	OSHA 10, Pass Probation	Work Independently	6 months	OSHA 30
F	OSHA 10	N/A	4 months	12 months	NABCEP Accredited Classes, SunPower Master Certification
G	8 hours of supervision on jobsite	N/A	Work Independently	6 months	Electrical License
H	5 hours online safety training	At least 6 months at PV1	92% QC rating, work independently using SOP	At least 6 months at PV2, Install 0.150 kW per Hour	92% QC rating, attitude and office involvement
I	4 Hours Safety with Crew Lead	OSHA 10, Forklift, Work Independently	SEI PV101 Course	6-9 months	Some kind of management course
J	3 Hours Safety Training with Solar Manager	N/A	Met professional goals	12 months	Can Interface with Customer, Manage crew

A breakdown of the training practices financed by those companies both immediately after hire, and throughout an average employee's career, are summarized in the table on page 4. All companies have been kept anonymous.

Each of the ten companies interviewed had varying forms of on-boarding and training for entry-level installers, exemplifying the diverse approaches to post-hire training in the solar industry.[18] **However, almost all of the companies expressed similar opportunities for rapid advancement and promotion to a PV3/Senior Installer position after only 6-12 months of work and training.** Vertical movement within these companies was not just in title, but consisted of pay raises that reflect their value-add through significantly higher wages on average. **An average employee at one of these companies could see a 45% wage increase after less than one year of experience and training at the company.**

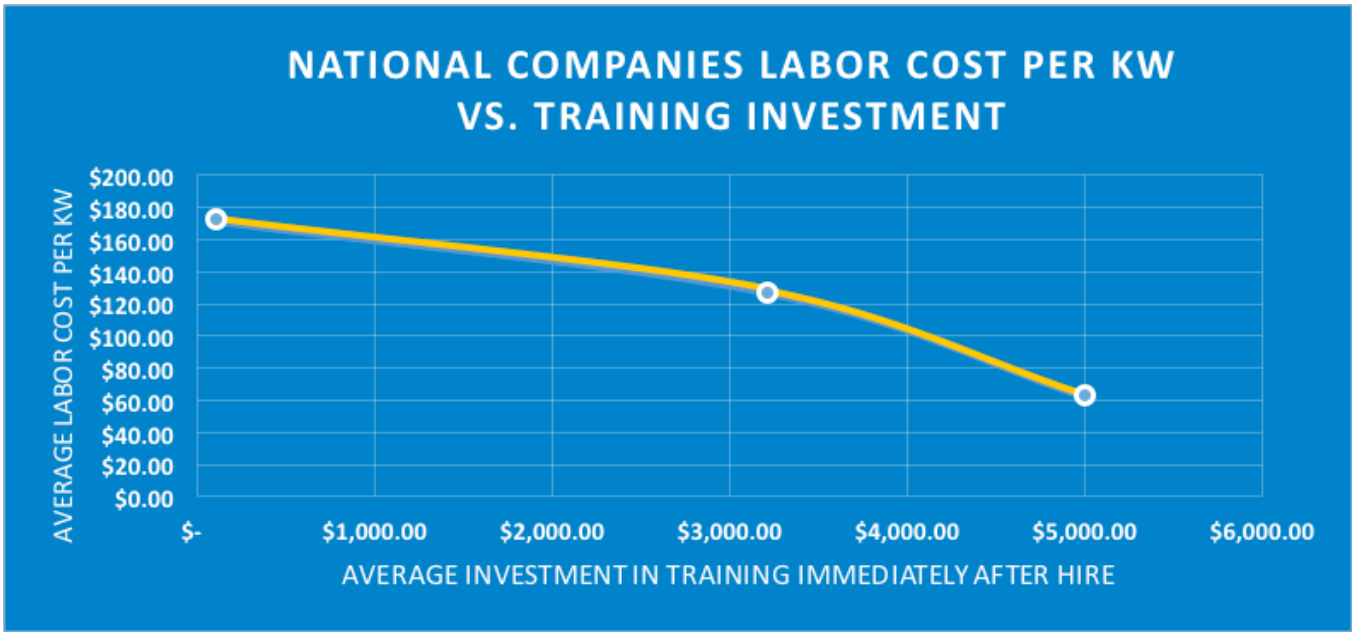
The relatively rapid promotions and pay increases witnessed in the ten companies surveyed are made less surprising when considering employer-reported difficulty finding employees with relevant work experience and adequate soft skills.[19] Within a year, an entry-level employee will have developed significant hands-on experience, and those without sufficient soft skills can be quickly weeded-out.

Though the sample size of companies interviewed was relatively small, three of the ten employers were large multi-state companies that, when combined, accounted for the majority of current solar hiring and capacity deployment in the United States.[20] These three companies all operate in more than seven states and are spread over diverse markets and policy environments. Averaging labor rates across multiple diverse markets lowers the possibility that these companies' costs are skewed by local policies and requirements. Additionally, these three companies can achieve the most comparable economies of scale. These factors make them the most apt in the sample to compare returns on their investments in training.

When these three companies are compared there is a downward trend in average labor costs with increased investment in employee training. The most efficient solar installer in the sample, reporting $65 of installation labor per kW installed, also committed the largest investment in training new employees at $5,000 per installer. Comparatively, the median company investment amongst the ten employers was approximately $100 per employee, and indicated nearly double

HOURLY WAGE DATA FOR INSTALLERS, BY POSITION.

Hourly Wage Summaries					
	Entry-Level No Experience (PV1)	Some Experience (PV1)	Some Solar Experience (PV2)	Sr. Installer (PV3)	Crew Lead
Range	$10 - $23	$10.50 - $23	$16 - $27	$15 - $32	$20 - $48
Mean	$13.93	$14.14	$18.64	$20.50	$33.68
Median	$13.00	$13.50	$17.00	$20.00	$35.00



the labor costs at $130 per kW installed. While not statistically conclusive, this comparison supports the concept, seen in similar industries, that a company can experience a return on investment in training after hire. While these companies represent the majority of current hiring in the U.S., additional analysis is needed to provide statistically significant results.

By working with solar installers, training providers can help the solar industry decrease labor-related soft costs and increase PV deployment broadly by developing improved incumbent worker training opportunities. Through this research and improved industry communications, training providers can also gain a better understanding of what solar employers are looking for in entry-level candidates and help decrease the difficulty finding and retaining qualified employees through improved prior-to-hire training programs.

WHAT EMPLOYERS ARE LOOKING FOR

In the last several years there has been a maturation and proliferation of solar PV Balance of Systems (BOS) equipment, including racking and power control systems. Many companies have taken this opportunity to develop their own installation techniques and procedures based on the products they prefer and believe offer them a competitive advantage. Consequently, companies have produced a suite of programs and techniques for teaching associated product- and company-specific installation practices after hire, as seen above. **Employers correspondingly report that they look less to installation-specific training among job applicants, and place more value on those experiences that develop technical abilities, safety techniques, and soft skills that are common to all companies.** A lack of traditional in-depth training, degrees, certifications, and electrical licenses are not holding back entry level applicants, but seem to hold more value for incumbent employees looking to take on greater levels of responsibility and leadership within their organization.

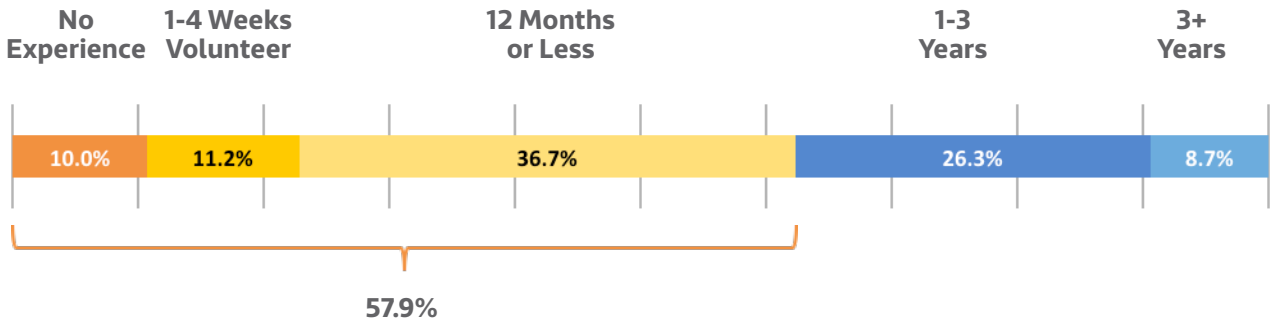
Overall, the research indicates that an *ideal* entry-level solar installer candidate would have some prior solar or construction trade experience (less than one year is acceptable for most employers), with some basic electrical knowledge, familiarity with PV system

installation, and understanding of safety protocols. Employers indicate that there needs to be *more* training (not per student, but generally), and that they would benefit from access to industry standardized on-the-job training programs for both new hires and incumbent employees. Training providers should connect with their local employers to develop hands-on opportunities for entry-level trainees, as well as more in-depth up-skilling programs for existing employees. This will ensure training effectively prepares students with the appropriate *level* of skills and experiences employers are looking for, and help incumbent solar workers advance their careers.

A. Previous Experience

Solar employers express relatively low expectations for the desired level of previous work experience in entry-level applicants. As discussed above, a lack of relevant work experience was the most commonly cited (77.9%) reason for difficulty hiring. This is despite the fact that **a majority of installation companies (57.9%) expect less than a year of experience in a comparable position for entry level candidates,** with 21.2% of those expecting either no formal experience or 1-4 weeks as an apprentice, intern, or volunteer in a comparable position.

LEVEL OF EXPERIENCE EXPECTED FOR ENTRY-LEVEL CANDIDATES



Entry-level solar positions therefore appear to be well suited to job seekers moving laterally from similar industries. Electrical experience, soft skills (work ethic, dependability, critical thinking), and roofing experience ranked highest in terms of areas of expertise that are most difficult to find in solar job applicants. These skills can be developed and demonstrated to employers through non-solar experience in a variety of previous positions. **A majority of employers (61%) consider experience in a non-solar construction trade important to their hiring considerations.** Additionally, employers value more than just full-time experience; over half (57%) of employers also find a solar apprenticeship[21] or internship important when considering new applicants.

B. Training

Generally, employers believe that the solar industry would benefit from additional and improved solar training and education for installer applicants and incumbent employees. **Over three quarters (79.6%) of employers stated that there was a general need for additional solar training.** However, in another response, only 40.9% of employers stated that completion of a semester-long course in solar installation training is either "important" or "somewhat important" for entry-level installers.

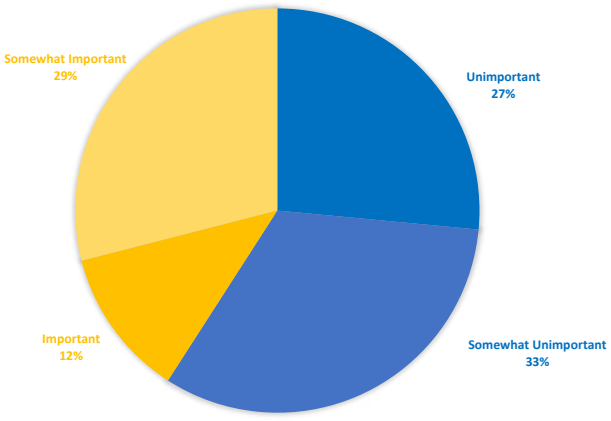
There is a clear desire for some form of solar training and increased skill development for entry level positions, but it is not clear if increased traditional semester-long courses would adequately address those needs for entry-level employees.

The disconnect over the appropriate level of training does not necessarily indicate that the standard 40+ hour course has no place in today's solar industry, nor does it mean that prior-to-hire training in general is not valued. Rather, the level of detail covered in semester-long courses likely holds more value for incumbent workers looking to advance their careers within a company.

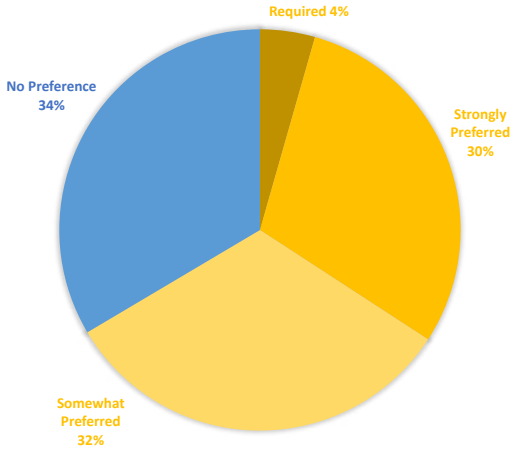
C. Certifications

Skilled technical industries rely upon standardized certifications as benchmarks for employee competency. However, compared to some similar industries such as electrical or plumbing, there is generally less emphasis on certifications in the solar industry.[22] **Currently, the solar industry is almost evenly split on the importance of *entry-level* installers obtaining a solar certification, with 48.1% considering it either important or somewhat important, and 51.9% considering certifications unimportant.**

IMPORTANCE OF COURSE COMPLETION



NABCEP EXAM PREFERENCES



The North American Board of Certified Energy Professionals (NABCEP) Associate Exam is the most widely-recognized solar industry certification. Sitting for the exam requires the completion of a 40-hour course, built upon the NABCEP Associate Learning Objectives which were developed with input from a broad cross-section of solar installers and equipment manufacturers.[23] When hiring entry-level solar installation workers, over half (62%) (62%) of employers stated they prefer NABCEP exam passage; however, only 0.8% of employers require a NABCEP certification, and 49.1% do not consider it important in evaluating entry-level candidates. Comparatively, more employers considered completion of a solar apprenticeship (57.4%) or construction experience (61.4%) important in their hiring decision than a certification.

A real-time labor market information analysis tool – TalentNeuron – was used to analyze more than 800 open solar PV installer positions throughout the U.S. in January 2017. The results corroborated the installer survey responses given above. Of these entry-level positions advertised online, less than 10% referenced a preference for, or requirement of, NABCEP credentials, and one in four (24%) indicated a preference for, or requirement of, OSHA certification.

EMPLOYER TRENDS IN POST-HIRE TRAINING

Once a solar employer decides to bring on a new hire, they have a broad range of resources and options available to continue to train and upskill that employee, filling gaps that may still exist in their skillset. Post-hire training can take many forms, including formal on-the-job training programs, third-party training and certifications, mentorship, internship and apprenticeship programs, and more. Many larger companies have the ability to create standardized, in depth, onboarding and training for all employees regardless of their background. In contrast, smaller companies tend to rely more heavily on training provided by crew leads or third-party providers. Many federal, state, and private programs exist to help facilitate and fund workforce development and training. Nevertheless, dozens of interviews with employers, training providers, and workforce development boards across the country indicate that such programs are largely underutilized by the solar industry.

A. On-the-Job Training

Only 34% of employer respondents to the broad 400+ employer survey indicated that they provide a formal on-the-job training (OJT) program. Of those that offer OJT, the average training length was 40-hours. Safety training was the primary focus of most OJT programs. Over two thirds (65%) of OJT programs include OSHA safety training, with the majority (63%) offering the 10-hour OSHA training course, a quarter (24%) offering both 10 and 30 hour courses, and 14% offering only the 30-hour course. The next most frequently covered topics, with about 5 hours each, include system components, solar energy fundamentals (mainly related to installation), and electricity basics (also tied to components). Other training includes product-specific training offered by manufacturers, utilized by 63.9% of employers for part of their OJT, each averaging about 8 hours.

Only 42.7% of installers use outside training providers not employed directly by their company as a part of their OJT, and only 40.9% of OJT programs included a classroom component. Almost two-thirds (63.6%) of those that do offer classroom training with a third-party trainer send their employees to the training provider's facilities for training. However, most installers (59.2%) do not currently have relationships with local training providers, such as community colleges.

Solar companies generally rely most heavily on internally developed materials versus those produced by industry organizations to deliver OJT. A majority of respondents (55%) rely on some form of tool, checklist, or application, with most (54%) using *company specific* checklists, training, and processes. **With that said, two thirds (66%) of respondents stated that a standardized industry-wide OJT training program would be highly valuable to their company.** The three topics which companies felt would be most valuable to cover in a standardized training program were:

- System Installation and Connection (78%) including basic knowledge of system components and basics of installation/ connection of a system
- System Components (75%) including the ability to identify and correctly handle solar system components
- Electricity Basics (75%) including basic electrical principals and common electrical system components

B. Workforce Development Tools and Resources

Tools and resources that help attract, train, and retain qualified workers can be essential to the development of a nascent industry. These workforce development tools and resources can range broadly in form, and are both privately and publicly developed and maintained by a large number of organizations. However, the target audiences and recipients of these tools and resources, often small local employers or solar training providers, typically do not have the time or means to seek out, learn about, and take advantage of the tools and resources available to them.

Workforce development boards (WDBs), solar training providers, and solar employers were interviewed regarding their knowledge and use of available solar training tools and resources, the perceived usefulness of available resources, and ideal tools and resources that are not yet available. The solar industry members and training providers indicate a need to stay up-to-date on, and learn about, current workplace

AVAILABLE TOOLS AND RESOURCES FOR THE SOLAR INDUSTRY, BY CATEGORY [24]

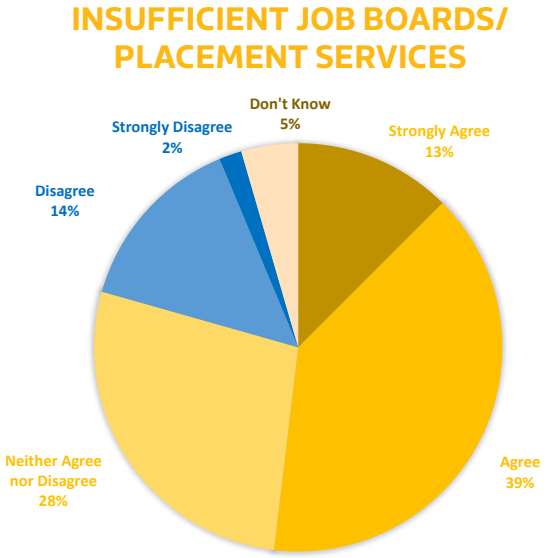
Training Resources	Workforce Board Services	Recruitment Resources	Workplace Tools
Solar Training Network	WIOA Funded On-the-Job Training	Solar Career Map	Solar Pathfinder Kit
Solar Ready Vets	WIOA Funded Work Experience	Skills Gap Analysis	PV Watts
SITN Best Practices	Veteran Services	Renewable Energy Competency Model	Quick Reference Guides
NABCEP Credentials	ITA Training	Job Fairs	Standard Work Specifications
IREC Credentials	Targeted Occupation List	Industry Events	Technical Standards
NCCER Curriculum and Credentials	Labor Market Data	Job Boards	Standardized Permitting Systems
Certificate Programs (A.S. Degrees)	Apprenticeship		
Vendor Provided	YouthBuild		
Internships	Americas Promise		
Modular Training	TAACCCT		
Stackable Credentials Multiple Credentials	Sector Strategy		
Continuing Education			
GEARED			

tools, but are unaware of any centralized clearinghouse to find such information. A list of tools and resources identified through literature review and by interviewees, separated by type, , can be found on page 10.

Workforce Development Boards have their own internal recruitment resources that are available to both job seekers and businesses; however, typically these are standard resources that do not reflect any customization for the solar industry. While funding programs through the Workforce Innovation and Opportunity Act, and other federally-funded programs, can typically be used for solar training, several administrative steps often need to be taken prior to federal and state approval. Thus far, WDBs report minimal use of these funding sources for solar programs. Solar champions at local WDBs, industry support, and additional local solar labor market information could help drive greater utilization of these resources.

Solar employers utilize a variety of tools to locate and recruit potential employees. In interviews solar employers indicated a preference for combining solar career fairs with other solar industry events. Many employers felt that adding an introductory training component to such events would be highly beneficial; however, most solar trainers do not currently attend or participate in solar job fairs or industry events. IREC created and hosts several tools that can be useful in recruitment, training, and career development in the solar industry.[25] These include the Solar Career Map, Solar Competency Models, and a solar Skills Gap Analysis tool. However, solar trainers and employers interviewed were generally not familiar with these tools.

In terms of active recruiting for job candidates by employers, word of mouth was most often used (77%), followed by internet job postings on career websites (63%), then direct recruitment from known training programs



(19%). **Over half (51.9%) of respondents "strongly agreed" or "agreed" that current job boards and placement services are insufficient or difficult to use.** Employers report that they almost exclusively utilize generic job boards and would consider a solar-specific job board valuable if available.[26]

Many skilled trades, such as electrical, have more standardized work processes and have developed quick reference guides for their industry. Standardized on-the-job training, reference guides, and other tools have not yet been widely developed or accepted by the solar industry.[27] **All interviewees indicated that standardizing workplace practices and tools to the extent possible would support the growth of the solar industry.**

C. Mentorships, Apprenticeships, and Internships

Over three quarters (77%) of industry respondents did not have formal mentorship or apprenticeship programs. Despite these current low numbers, interviews with solar employers revealed that this is a highly desired and valued experiential component for interested solar candidates. Additionally, only about one out of four respondents were aware if their organization had a diversity

hiring program, and less than 20% were aware whether their company had a formal veteran hiring program.

The Workforce Innovation and Opportunity Act, along with other federal and state programs, provides funding for on-the-job training or internship opportunities for certain disadvantaged groups, however, very few solar installers were aware of, or actively utilizing, these programs. The gap between demand and adoption of such programs indicates that there is a lack of awareness in the industry about such programs, and that the cost or sophistication required to take advantage of them may be limiting use by the industry. The creation of tools and educational materials that teach employers about how to access these opportunities could help bring more resources for development of beneficial training programs for underserved group into the solar industry.

GEOGRAPHIC NEED FOR DEPLOYMENT OF WORKFORCE DEVELOPMENT RESOURCES

An insufficient supply of qualified and well-trained solar workers in a local economy can slow the growth of that solar market. However, many efforts to expand solar training have been criticized for promoting such training in areas where there was not sufficient hiring demand to meet the new supply of labor. Solar training providers and workforce development boards, often the groups trying to create new training programs, have expressed frustration with inadequate local solar market information. **Decision makers, responsible for the justification and allocation of workforce development resources, need a better understanding of the geographic distribution of solar workforce supply and demand.**

To help determine which states have the highest need for additional training investment and deployment of workforce development resources, a Geographic Demand Index ("the Index") was developed. The Index uses seven unique factors to analyze three general characteristics of the solar workforce market in each state. The seven factors were standardized using either the state's total jobs, or total solar jobs. Each factor was given a weight based on that factor's potential impact on the future gap between solar workforce demand and supply. The three general characteristics are Recent Market Trends, Projected Market Trends, and Training Supply Indicators for each state.

GEOGRAPHIC DEMAND INDEX FACTOR WEIGHTING, BY CATEGORY

Recent Market Trends (2015-16 Job Growth By Sector)	
Solar Non-Installation Jobs	15%
Solar Installation Jobs	20%
Projected Market Trends (2016-2019 Labor Projections)	
Residential Installation Jobs	20%
C&I Installation Jobs	10%
Utility Installation Jobs	5%
Training Supply Indicators	
Reported Difficulty Hiring	20%
Training Providers	10%

All of the factors are arranged to point towards a future gap between demand for qualified solar installers and the local supply of well trained workers. Those states with a high Index value are not those with the greatest need for total workforce development support in terms of actual dollars or other resources, but rather have a higher likelihood of seeing a solar workforce

TOP STATES WITH DEMAND FOR SOLAR WORKFORCE DEVELOPMENT

Rank	State	Total 2016 Solar Jobs
1	Vermont	1,767
2	New Mexico	2,929
3	California	100,050
4	Oregon	4,509
5	Delaware	363
6	Utah	4,408
7	New Hampshire	1,184
8	Colorado	6,004
9	Nebraska	1,585
10	Indiana	2,700

shortage in coming years. The results, including ranking for each factor, can be found in a table below.

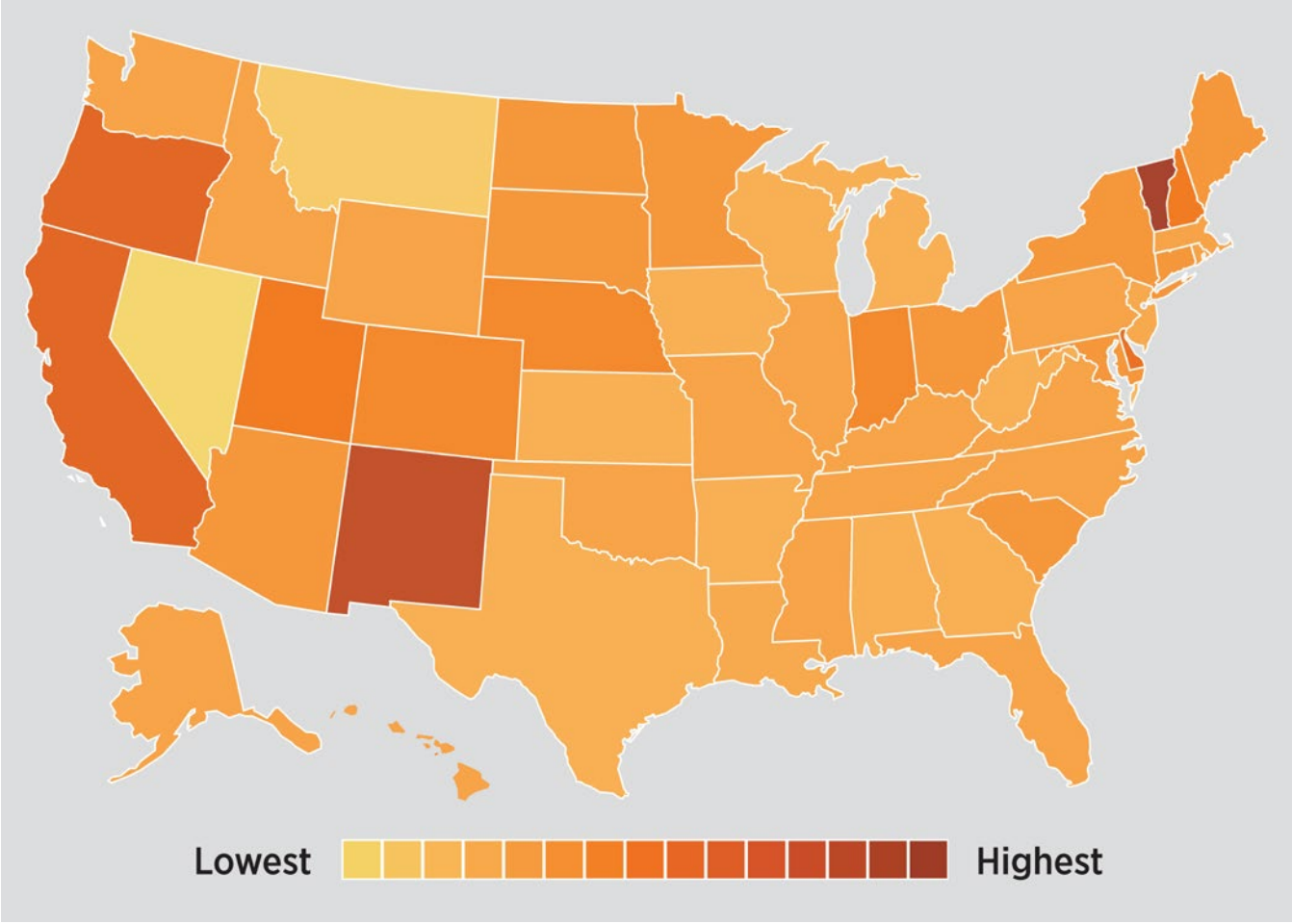
Vermont, the state with the highest total Index score by a significant margin, is a prime example of why the highest score does not necessarily indicate the greatest *amount* of additional resources needed. With a solar workforce about two percent the size of California's, far fewer workforce resources would likely need to be deployed to meet the growing training workforce of Vermont. Still, Vermont's solar jobs grew 58 times faster than the overall state economy in 2016[28], and they are projected to see the largest solar jobs growth relative to their total state workforce in 2017.

Vermont's growth and demand for additional workers is likely driven by an aggressive Renewable Portfolio Standard that was recently passed[29], in addition to solar-friendly net metering and interconnection policies.[30] The state ranks high on a jobs per-capita basis, but still is a relatively small overall market, with 1,767 total solar jobs in 2016.[31] New Hampshire, ranking 7th, is a similar state, with a strong per capita solar job market in a small but quickly growing workforce, with solar-friendly policies and high electricity rates driving residential solar growth.

California, Nevada, and Massachusetts have historically lead the charge for solar employment, all ranking in the top five for total solar jobs and solar jobs per capita, however, they have drastically different Index values for a variety of reasons. California led the nation

in solar job growth, adding 24,452 new jobs in 2016, and, according to their high Index score, it seems their workforce pipeline has not had a chance to catch up with the rapid expansion, and will not in the coming years.[32] Nevada, however, has recently seen shifts in state policy that played a large part in the loss of 2,687 installation jobs last year. Nevada already has the lowest reported difficulty finding solar workers and has the lowest Index score of all fifty states. As a result of the shrinking number of jobs, employers are likely finding an ample supply of candidates with at least some previous solar experience, compared to states seeing continuous growth in installation jobs. Massachusetts, the state with the highest solar jobs per capita, sits fairly low on the Index, ranking 31st, and lost 1,738 installation jobs in 2016. The State's solar workforce, like several others that saw installations increase but lost jobs last year, may be experiencing heavier interstate competition, increased labor efficiency, or simply the effects of cyclical fluctuations in development pipelines including a ramping up of installation in expectation of the reduction of the ITC at the end of 2015. Nevertheless, Massachusetts is expected to bounce back and see significant residential installation job growth over the next three years, which may lead to increased demand for workforce development in the coming years.[33]

TOP STATES WITH DEMAND FOR SOLAR WORKFORCE DEVELOPMENT



New Mexico, Oregon, and Utah share many similarities. Each state has a relatively high density of solar jobs in their state (all rank 11th or higher for solar jobs per capita), experienced more than 50% growth in installation jobs in 2016, ranked in the top 20 for installed capacity in 2016, and have solar-friendly net metering and interconnection policies.[34] These states are all expected to have steady job growth in coming years and will likely see increased difficulty hiring if nothing else changes. Another similarity that should be considered by decision makers and others using this Index, is that these states all have solar job markets largely concentrated in a single metropolitan area.[35] Statewide policies and programs may be more effective in these states than in states with distinct regional markets, such as California.

While Nebraska's rank of 9th may seem surprising since it is expected to see relatively few solar installations in the coming years, the state experienced more than 100% growth in non-installation jobs, and 78% growth in installation jobs last year. While Nebraska's growth rate appears high because it is starting from a relatively small base, Nebraska employers also report a high level of difficulty hiring (9th) and Nebraska has the fewest recorded training centers per solar job in the country.

Training providers, industry groups, workforce development boards, and decision makers at all levels can use the Index, and additional information included in the table below, to make more informed decisions about the deployment of limited resources. The Index will be updated by the Solar Training Network as new data become available.

GEOGRAPHIC DEMAND INDEX, 2016

		2015-2016 Change in Solar Jobs by Sector				2016 - 2019 Projections			Supply Indicators			
	2016 Jobs	Solar Non-Installation Jobs		Solar Installation Jobs		Resi. Install Jobs	C&I Install Jobs	Util. Install Jobs	Difficulty Hiring	Training Providers	Total Demand Score	
State	2016 Solar Jobs	Change 2015-16	Rank	Change 2015-16	Rank	Rank	Rank	Rank	Rank	Rank	Rank	State
Alabama*	530	89	41	154	28	43	39	42	35	49	48	AL
Alaska*	64	18	38	13	35	28	44	35	30	1	33	AK
Arizona	7,310	-462	51	850	9	5	18	14	31	19	15	AZ
Arkansas*	271	-1	49	8	39	41	36	5	40	1	41	AR
California	100,050	11820	3	12632	2	4	11	46	32	12	3	CA
Colorado	6,004	972	10	34	37	15	5	17	19	20	8	CO
Connecticut	2,174	267	22	-44	43	9	3	19	28	45	12	CT
Delaware*	363	-1	50	-88	48	2	2	35	33	43	5	DE
D.C.	1,180	136	21	43	32	-	-	-	-	-	-	DC
Florida	8,260	984	26	716	26	13	24	41	39	25	29	FL
Georgia	3,924	60	44	680	18	35	40	47	46	14	45	GA
Hawaii	3,194	366	5	14	36	50	50	7	1	15	23	HI
Idaho*	611	59	32	170	11	32	35	48	24	1	26	ID
Illinois	3,718	278	40	-42	41	30	31	29	18	35	34	IL
Indiana	2,700	739	17	394	21	26	16	39	4	22	10	IN
Iowa	563	127	35	88	33	21	21	25	5	50	47	IA
Kansas*	467	171	25	14	38	20	42	34	9	47	42	KS
Kentucky*	1,202	202	29	-2	40	42	44	38	9	36	32	KY
Louisiana	2,922	698	11	250	22	48	28	31	35	1	21	LA
Maine	572	19	43	223	7	24	33	12	1	48	17	ME
Maryland	5,429	297	28	862	8	14	7	8	38	34	13	MD
Massachusetts	14,582	1225	12	-1738	50	11	49	23	26	18	31	MA
Michigan	4,118	1040	18	300	30	25	25	18	48	33	43	MI
Minnesota	2,872	101	42	776	10	34	22	45	7	39	20	MN
Mississippi*	883	110	30	214	15	44	44	2	37	1	24	MS
Missouri	2,380	233	33	293	24	29	19	20	47	16	39	MO
Montana*	168	6	45	53	23	18	12	43	23	51	49	MT
Nebraska*	1,585	578	4	230	12	46	44	33	9	1	9	NE
Nevada	8,371	2294	1	-2687	51	49	13	50	50	13	50	NV
New Hampshire*	1,184	172	16	281	5	7	6	28	27	40	7	NH
New Jersey	6,056	40	48	-1055	49	8	14	40	17	24	27	NJ
New Mexico	2,929	447	7	582	3	3	4	1	6	28	2	NM
New York	8,135	617	36	-732	45	10	8	27	20	31	16	NY
North Carolina	7,112	219	39	942	13	16	20	44	28	46	36	NC
North Dakota*	175	34	34	23	34	38	41	10	9	1	19	ND
Ohio	5,831	634	27	386	29	36	26	13	9	27	18	OH
Oklahoma*	814	195	24	224	20	37	38	21	40	30	38	OK
Oregon	4,509	746	9	764	6	6	10	4	3	17	4	OR
Pennsylvania	3,061	58	47	505	27	17	34	32	21	41	37	PA
Rhode Island	1,176	268	6	-33	44	39	30	15	49	1	35	RI
South Carolina*	2,772	875	8	132	31	22	23	11	9	32	11	SC
South Dakota*	478	86	19	73	17	47	44	26	9	1	14	SD
Tennessee	3,548	260	31	-510	47	33	15	22	22	1	30	TN
Texas	9,396	3853	15	-1488	46	31	27	37	44	26	40	TX
Utah	4,408	476	13	1253	1	12	9	49	8	21	6	UT
Vermont	1,767	219	2	180	4	1	1	3	42	29	1	VT
Virginia	3,236	721	20	552	19	19	17	16	16	44	25	VA
Washington	3,681	1081	14	338	25	27	29	24	43	23	28	WA
West Virginia*	381	39	37	-8	42	45	43	9	33	42	46	WV
Wisconsin	2,813	387	23	485	16	23	32	30	45	38	44	WI
Wyoming*	152	3	46	60	14	40	37	6	24	1	22	WY

CONCLUSION

As consumers continue to see ever-lower prices for solar, the solar industry is poised to see continued job growth well above the national average in the coming years, despite a projected slowing in pace. There is no indication that the high levels of difficulty finding and hiring qualified solar workers seen today will lessen without some form of industry change. The difficulty experienced by solar installers does not appear to be a result of overly burdensome barriers to entry, and is reportedly costing employers tens of thousands of dollars. Training providers should work closely with employers to improve solar training both before and after hire. Prior-to-hire training should focus on providing a preliminary understanding of system components and electrical basics, safety techniques, softs skills, and should maximize opportunities for hands-on worksite experience. Training providers should also work with employers to develop company specific on-the-job training or internship opportunities.

Along with low barriers to entry, there are staggering opportunities reported for rapid advancement for an entry-level solar installer. Entry-level installers can see promotions to a senior installer position within the first 6-12 months of employment, which can be accompanied by a 45% increase in pay. The solar industry should work together to continue to educate, and foster interest in, potential solar employees about the possibilities that a career in the solar industry presents. Additionally, employers, and especially trainers, should take better advantage of the underutilized resources offered by workforce boards and development organizations.

It is clear from this report, and other research identified through this effort, that companies can witness greater labor installation efficiencies and fewer call-backs through improvements in training. While this study saw an initial trend that companies with larger investments in employee training had lower overall installation labor costs, additional research should be performed to determine a stronger correlation. A deeper study comparing return on investments for specific training methodologies could help the industry determine how employers and trainers can best train both entry-level and incumbent employees. Employers and training providers should communicate more openly about best practices and lessons learned to improve training. The creation of a central clearinghouse of existing tools and resources that can help employers develop and provide training opportunities would be pivotal in raising awareness and use of these underutilized programs.

As training practices are improved, workforce development resources should not be deployed blindly or uniformly, but rather should be utilized in those geographic regions that are most likely to have an underserved market for qualified solar workers. The gap between solar workforce supply and demand is affected by a multitude of factors and varies greatly over time and between regions. The Geographic Demand Index, developed through this research effort, should be continuously updated and expanded upon to provide the industry and decision makers the most accurate information for the effective deployment of limited resources.

Through unified stakeholder collaborations and continued research, the solar industry can improve training to better suit its unique and changing marketplace. Effective training and workforce development can not only bring down costs for employers, but can also foster a healthier workforce pipeline that enables local solar markets to fully realize their potential.

Endnotes

1. The full report is available to members of the Solar Training Network at www.solartrainingUSA.org
2. Solar Energy Industries Association, GTM Research, U.S. Solar Market Insight, 2016 Q3 Report.
3. The Solar Foundation, National Solar Jobs Census 2016.
4. Id.
5. Id.
6. This is supported by a CEG TalentNeuron analysis which gives current solar installer and electrician open positions a score of 60 out of 100 in "difficulty-to-fill."
7. Id. at 49.
8. This combines the percentage of firms reporting both "significant difficulty" with those reporting that finding qualified applicants is at least "somewhat difficulty."
9. The Solar Foundation, National Solar Jobs Census 2016.
10. Department of Energy, SunShot Initiative. http://energy.gov/eere/sunshot/soft-costs
11. Studies by the Rocky Mountain Institute concluded that soft costs for residential PV systems in the US are roughly twice the amount of Australia's and four times the amount of Germany's. These soft costs are respectively $1.22, $0.65, and $0.33 per Watt installed. Available at http://www.rmi.org/simple#simplebosform
12. Barry Cinnamon, et al. "WHITE PAPER: Solar Panels Last 25 Years – But Will They Stay Safely Attached to Your Roof? The Importance of Reliable Solar Mounting Systems," 2014. Available at http://cinnamonsolar.com/wp-content/uploads/2013/05/The-Importance-of-Reliable-Solar-Mounting-Systems-White-Paper_March-2014-copy.pdf
13. Assuming 300,000 installations in a year (which is less than the total installations in 2015), and using an average $5,000 in avoided costs per incident, this would lead to $15,000,000 in savings.
14. Sageer, et al. 2012. Identification of Variables Affecting Employee Satisfaction and Their Impact on the Organization.; Hausknecht, et. al. 2008. Targeted Employee Retention: Performance-Based and Job-Related Differences in Reported Reasons for Staying; and Ramlall, S. 2004. A Review of Employee Motivation Theories and their Implications for Employee Retention within Organizations.
15. https://www.zanebenefits.com/blog/bid/312123/employee-retention-the-real-cost-of-losing-an-employee
16. Konings, J. & Vanormelingen, S. 2010. The Impact of Training on Productivity and Wages: Firm Level Evidence. http://ftp.iza.org/dp4731.pdf
17. The number of hours in this column reflects training that only pertains to solar installation, such as safety or basics of electricity and excludes topics on company policies and procedures.
18. See "Employer Trends in Post-Hire Training" below for more.
19. See "What Employers are Looking For" below for more.
20. According to a March 2017 analysis using TalentNeuron software.
21. The term "apprenticeship" is not defined as a traditional Department of Labor apprenticeship program (see Part 3 Tools and Resource below).
22. See e.g., National Electrical Contractors Association list of state code and licensing requirements, available at: http://www.necanet.org/professional-development/careers-in-electrical-contracting/licensure/state-code-licensing-requirements.
23. http://www.nabcep.org/wp-content/uploads/2016/08/NABCEP-PVA-Learning-Objectives-8.15.15.pdf
24. See full research report for a breakdown of each tool or resource, as well as reported awareness and usefulness of each tool or resource by various groups. Available at www.solartrainingusa.org.
25. See, http://www.irecusa.org/workforce-education/training-resources/.

26. The Solar Energy Industries Association does host a solar job board, however, solar installers do not currently report using this resource. Available at, www.seia.org/solar-jobs.
27. This is likely due to the broad proliferation of solar PV BOS equipment, including racking and power control systems, and other associated hardware used in the installation of a solar PV array.
28. The Solar Foundation, National Solar Jobs Census 2016.
29. Requiring retail electricity providers in the state to obtain 75% of their electricity from renewable energy sources by 2032.
30. Vermont received an A for net metering policies and a B for interconnection policies by Freeing The Grid. Available at, http://freeingthegrid.org/#state-grades/vermont
31. While Vermont ranks 31st for total Solar Jobs in 2017, they rank 3rd in solar jobs per capita. See, http://www.thesolarfoundation.org/solar-jobs-census/factsheet-2016-vt/
32. See, http://solarstates.org/#state/california/counties/solar-jobs/2016 for more information on California.
33. See, http://solarstates.org/#state/massachusetts/counties/solar-jobs/2016 for more information on Massachusetts.
34. Each state receive a B or higher for net metering and interconnection policies by Freeing the Grid. See, www.freeingthegrid.org.
35. See, http://solarstates.org for a county by county breakdown of job locations.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